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1 [Session 5: Undoing any operation in collaborative graphics editing systems](#)



David Chen, Chengzheng Sun

 September 2001 **Proceedings of the 2001 International ACM SIGGROUP Conference on Supporting Group Work GROUP '01**

Publisher: ACM Press

Full text available: pdf(249.64 KB)

 Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Undo is a useful and widely supported feature which can be used to recover from erroneous operations, learn new system features, and explore alternative solutions. The ability to undo any operation at any time is especially important for collaborative editing systems because it can be used to support local or global undo and also multiple undo models. The Any Undo solution presented in this paper is able to undo any operation in collaborative graphics editing systems. The major challenge in desi ...

Keywords: collaborative editing, concurrency control, consistency maintenance, distributed computing, graphics editing, multi-versioning, undo/red

2 [A temporal model for multi-level undo and redo](#)



W. Keith Edwards, Takeo Igarashi, Anthony LaMarca, Elizabeth D. Mynatt

 November 2000 **Proceedings of the 13th annual ACM symposium on User interface software and technology UIST '00**

Publisher: ACM Press

Full text available: pdf(264.83 KB)

 Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: Flatland, Timewarp, history management, redo, timelines, undo

3 [A formal approach to undo operations in programming languages](#)



George B. Leeman

 January 1986 **ACM Transactions on Programming Languages and Systems (TOPLAS)**, Volume 8 Issue 1

Publisher: ACM Press

Full text available: pdf(2.74 MB)

 Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

A framework is presented for adding a general Undo facility to programming languages. A discussion of relevant literature is provided to show that the idea of Undoing pervades several areas in computer science, and even other disciplines. A simple model of computation is introduced, and it is augmented with a minimal amount of additional

structure needed for recovery and reversal. Two different interpretations of Undo are motivated with examples. Then, four primitives are defined in a langu ...

4 Design: Dynamic hierarchical undo facility in a fine-grained component environment

Hironori Washizaki, Yoshiaki Fukazawa

February 2002 **Proceedings of the Fortieth International Conference on Tools Pacific: Objects for internet, mobile and embedded applications CRPIT '02**

Publisher: Australian Computer Society, Inc.

Full text available:  [pdf\(838.08 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The undo facility is essential for interactive application systems. In conventional object-oriented software development, undo facilities have been implemented based on undo frameworks. However, the use of undo frameworks costs a great deal in both the development and maintenance stages. In this paper, we propose a new technique by which an undo facility can easily be implemented in component-based applications using changes of the component properties. However, since the granularity of the comm ...


Keywords: component-based development, undo mechanism, user interfaces

5 A selective undo mechanism for graphical user interfaces based on command objects

Thomas Berlage

September 1994 **ACM Transactions on Computer-Human Interaction (TOCHI)**, Volume 1 Issue 3

Publisher: ACM Press

Full text available:  [pdf\(1.78 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

It is important to provide a recovery operation for applications with a graphical user interface. A restricted linear undo mechanism can conveniently be implemented using object-oriented techniques. Although linear undo provides an arbitrarily long history, it is not possible to undo isolated commands from the history without undoing all following commands. Various undo models have been proposed to overcome this limitation, but they all ignore the problem that in graphical user interfaces a ...


Keywords: command objects, groupware, undo

6 Undo any operation at any time in group editors

Chengzheng Sun

December 2000 **Proceedings of the 2000 ACM conference on Computer supported cooperative work CSCW '00**

Publisher: ACM Press

Full text available:  [pdf\(183.08 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The ability to undo operations is an indispensable feature of real-time group editors, but supporting group undo is a difficult problem. None of the existing solutions for group undo is able to support undoing any operation at any time with guaranteed success. In this paper, we contribute a novel group undo solution with such a capability. The basic idea is to interpret an undo command as a concurrent inverse operation by means of operational transformation, so that an operation is always ...

Keywords: distributed computing, group editors, group undo, groupware, operational transformation


7 A framework for undoing actions in collaborative systems

Atul Prakash, Michael J. Knister

December 1994 **ACM Transactions on Computer-Human Interaction (TOCHI)**, Volume 1

Issue 4

Publisher: ACM Press

Full text available:  [pdf\(2.54 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The ability to undo operations is a standard feature in most single-user interactive applications. We propose a general framework for implementing undo in collaborative systems. The framework allows users to reverse their own changes individually, taking into account the possibility of conflicts between different users' operations that may prevent an undo. The proposed framework has been incorporated into DistEdit, a toolkit for building group text editors. Based on our experience with Dist ...

Keywords: DistEdit, computer-supported cooperative work, concurrency control, groupware, selective undo, state recovery, undo, user recovery


8 A generic operation transformation scheme for consistency maintenance in real-time cooperative editing systems



Chengzheng Sun, Yanchun Zhang, Xiahua Jia, Yun Yang

November 1997 **Proceedings of the international ACM SIGGROUP conference on Supporting group work: the integration challenge GROUP '97**

Publisher: ACM Press

Full text available:  [pdf\(1.55 MB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: CSCW, consistency maintenance, cooperative editing, distributed computing, intention preservation

9 Undoing actions in collaborative work



Atul Prakash, Michael J. Knister

December 1992 **Proceedings of the 1992 ACM conference on Computer-supported cooperative work CSCW '92**

Publisher: ACM Press

Full text available:  [pdf\(846.89 KB\)](#)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: collaboration, conflict analysis, groupware, undo

10 Undo for anyone, anywhere, anytime



James O'Brien, Marc Shapiro

September 2004 **Proceedings of the 11th workshop on ACM SIGOPS European workshop: beyond the PC EW11**

Publisher: ACM Press

Full text available:  [pdf\(71.09 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#)

Computer systems are complex and unforgiving. Users need environments more tolerant of errors, allowing them to correct mistakes and explore alternatives. This is the aim of Joyce. Joyce records application usage across the system in such a way that the semantic relationships between individual operations are preserved. Using this information Joyce enables an exploratory model of undo/redo; the user can navigate, visualize, edit and experiment with the history of the system safe in the knowledge ...

11 ARIES: a transaction recovery method supporting fine-granularity locking and partial rollbacks using write-ahead logging



C. Mohan, Don Haderle, Bruce Lindsay, Hamid Pirahesh, Peter Schwarz

March 1992 **ACM Transactions on Database Systems (TODS)**, Volume 17 Issue 1

Publisher: ACM Press

Full text available:  [pdf\(5.23 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

DB2TM, IMS, and TandemTM systems. ARIES is applicable not only to database management systems but also to persistent object-oriented languages, recoverable file systems and transaction-based operating systems. ARIES has been implemented, to varying degrees, in IBM's OS/2TM Extended Edition Database Manager, DB2, Workstation Data Save Facility/VM, Starburst and QuickSilver, and in the University of Wisconsin's EXODUS and Gamma d ...

Keywords: buffer management, latching, locking, space management, write-ahead logging

12 Operational transformation in real-time group editors: issues, algorithms, and achievements



Chengzheng Sun, Clarence Ellis

November 1998 **Proceedings of the 1998 ACM conference on Computer supported cooperative work CSCW '98**

Publisher: ACM Press

Full text available:  [pdf\(1.28 MB\)](#)

Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: causality preservation, consistency maintenance, convergence, distributed computing, group editors, groupware, intention preservation, operational transformation

13 Model and verification of a data manager based on ARIES



Dean Kuo

December 1996 **ACM Transactions on Database Systems (TODS)**, Volume 21 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(813.93 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

In this article, we model and verify a data manager whose algorithm is based on ARIES. The work uses the I/O automata method as the formal model and the definition of correctness is defined on the interface between the scheduler and the data manager.

Keywords: ARIES, I/O automata, system failures

14 Group editing algorithms: Achieving undo in bitmap-based collaborative graphics editing systems



Xueyi Wang, Jiajun Bu, Chun Chen

November 2002 **Proceedings of the 2002 ACM conference on Computer supported cooperative work CSCW '02**

Publisher: ACM Press

Full text available:  [pdf\(239.51 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Bitmap-based collaborative graphics editing systems are a special class of real-time collaborative editing systems. Undo is an important and difficult problem in these systems. Existing solutions show low efficiency because additional space cost should be added to achieve the function of undo. In this paper, we propose a new solution to resolve the undo problem. The basic idea is to reduce space cost through exploring relations among operations. The algorithm given in the paper can undo any oper ...

Keywords: CSCW, bitmap-based collaborative graphics editing systems, undo

15 A framework for shared applications with a replicated architecture



Thomas Berlage, Andreas Genau

December 1993 **Proceedings of the 6th annual ACM symposium on User interface software and technology UIST '93**

Publisher: ACM Press

Full text available: pdf(984.32 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Keywords: application framework, command objects, computer-supported cooperative work, history tree, selective undo and redo, user interface management system

16 Achieving convergence, causality preservation, and intention preservation in real-time cooperative editing systems



Chengzheng Sun, Xiaohua Jia, Yanchun Zhang, Yun Yang, David Chen

March 1998 **ACM Transactions on Computer-Human Interaction (TOCHI)**, Volume 5 Issue 1

Publisher: ACM Press

Full text available: pdf(273.05 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Real-time cooperative editing systems allow multiple users to view and edit the same text/graphic/image/multimedia document at the same time for multiple sites connected by communication networks. Consistency maintenance is one of the most significant challenges in designing and implementing real-time cooperative editing systems. In this article, a consistency model, with properties of convergence, causality preservation, and intention preservation, is proposed as a framework for consistency ...

Keywords: REDUCE, causality preservation, computer-supported cooperative work, consistency maintenance, convergence, cooperative editing, groupware systems, intention preservation, operational transformation

17 Anatomy of a native XML base management system

T. Fiebig, S. Helmer, C.-C. Kanne, G. Moerkotte, J. Neumann, R. Schiele, T. Westmann
December 2002 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 11 Issue 4

Publisher: Springer-Verlag New York, Inc.

Full text available: pdf(300.97 KB) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

Several alternatives to manage large XML document collections exist, ranging from file systems over relational or other database systems to specifically tailored XML base management systems. In this paper we give a tour of Natix, a database management system designed from scratch for storing and processing XML data. Contrary to the common belief that management of XML data is just another application for traditional databases like relational systems, we illustrate how almost every component in a ...

Keywords: Database, XML

18 The Recovery Manager of the System R Database Manager



Jim Gray, Paul McJones, Mike Blasgen, Bruce Lindsay, Raymond Lorie, Tom Price, Franco Putzolu, Irving Traiger

June 1981 **ACM Computing Surveys (CSUR)**, Volume 13 Issue 2

Publisher: ACM Press

Full text available: pdf(1.75 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

19 Concurrency control and recovery for balanced B-link trees

Ibrahim Jaluta, Seppo Sippu, Eljas Soisalon-Soininen

April 2005 **The VLDB Journal — The International Journal on Very Large Data Bases**,
Volume 14 Issue 2

Publisher: Springer-Verlag New York, Inc.

Full text available:  [pdf\(302.02 KB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#)

In this paper we present new concurrent and recoverable B-link-tree algorithms. Unlike previous algorithms, ours maintain the balance of the B-link tree at all times, so that a logarithmic time bound for a search or an update operation is guaranteed under arbitrary sequences of record insertions and deletions. A database transaction can contain any number of operations of the form "fetch the first (or next) matching record", "insert a record", or "delete a reco ...


Keywords: Concurrency control, Recovery, Transaction, Tree-structure modifications

20 Crash recovery in client-server EXODUS



Michael J. Franklin, Michael J. Zwillig, C. K. Tan, Michael J. Carey, David J. DeWitt
June 1992 **ACM SIGMOD Record , Proceedings of the 1992 ACM SIGMOD international conference on Management of data SIGMOD '92**, Volume 21 Issue 2

Publisher: ACM Press

Full text available:  [pdf\(1.50 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

In this paper, we address the correctness and performance issues that arise when implementing logging and crash recovery in a page-server environment. The issues result from two characteristics of page-server systems: 1) the fact that data is modified and cached in client database buffers that are not accessible by the server, and 2) the performance and cost trade-offs that are inherent in a client-server environment. We describe a recovery system that we have implemented for the client-ser ...

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